then the sea, stratification, coral; and lastly earthquakes and volcanoes.

Now this is just right. Physical Geography ought to contain the dynamics of geology, and not be a mere description of the physical condition of the globe. A description of the plateaus and primary mountain chains, and secondary mountain chains, and plains and river systems of all the countries in the world, and distribution of birds, beasts, and fishes, used to be what was called physical geography: and in it the dynamical element, all idea of change and progress was almost entirely left out. All this description constitutes geographical knowledge, but is of the nature of information pure and simple, and has absolutely no value in education except as an exercise in memory, and as a basis for reasoning, supposing that this reasoning is ever superposed. But what Prof. Geikie gives us is the very life and soul of geological science, observation on what the natural forces around us are doing, information as to what they are doing of the like kind elsewhere, and reasoning on the effect of these forces. It is a book which will at once rouse the curiosity of a child, and train it as far as it goes in sound scientific method.

It is admirably adapted to be a reading book in elementary schools, and it is much to be hoped that it will be largely used. But for this purpose a cheaper edition ought to be published. J. M. W.

OUR BOOK SHELF

Exalted States of the Nervous System. By R. H. Collyer, M.D. (H. Renshaw.)

IT can only be with a feeling of regret that anyone can see so many pages, nearly 150, occupied with matter and arguments most of which had much better have been retained only among the oral traditions of the author's acquaintances, for by publishing them he lays himself open to the severe criticisms of a non-appreciating scientific public. That Dr. Collyer was among the first to propose and employ anæsthetics, we will not question, but he cannot expect to increase the number of his supporters by the publication of such a work as the above, in which his want of knowledge of the first principles of scientific method and physiological fact is rendered too clear. An instance or two will suffice to indicate the manner in which the subject is treated. Speaking of chloral, he says—"It is administered by the stomach. . . . It seems that the action is immediate on the brain, through the eighth pair of nerves." This is very different from the explanation of the discoverer of that substance, and quite contrary to any explanation of value that has been since proposed. The physiological dogma on which the author bases many of his arguments is that "the lungs at every respiration send vital electricity to the brain, which has been thus assimilated to subserve the purposes of life." In a newspaper account of the relative chances of the Oxford and Cambridge crews for 1871, the author finds sufficient to justify the following valuable generalisation:—"thus endurance *does not belong* to mere size." We think these quotations sufficient.

The Botanists' Pocket-book: containing in a tabulated form the chief characteristics of British plants. By W. R. Hayward. (Bell and Daldy, 1872.)

A BOOK of modest pretensions, and not without its value. As a rule there is no class of scientific literature to be more carefully avoided than that which professes to compress the whole of the elements of a science into a small portable volume; nowhere is the master's hand more urgently required than in the compilation of text-books. Mr. Hayward we do not recollect to have met with before as a botanical writer; this little book, however, evidences great care in its preparation, and the author is careful not to claim for it too high a place. Its object is to "afford information to the tyro, and also to refresh the memory of the more advanced botanist who, by examining on the spot any doubtful plant, may be saved the trouble of carrying home specimens of little value; it is not intended as a book for the study, nor as a rival to the many excellent and complete manuals of our leading botanists; but to be accepted for what it is, viz., 'A Botanist's Pocket-book.'" This purpose it may well serve; occupying not much over 200 pages of thin paper in limp cloth binding, it will be no great burden to the pocket or knapsack, and may frequently be usefully resorted to by a young botanist on the tramp, leaving more careful study till he gets home. A. W. B.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Perception in the Lower Animals

As several persons seem interested in Mr. Wallace's suggestion that animals find their way home by recognising the odour of the places which they have passed whilst shut up, you may perhaps think the following little fact worth giving. Many years ago I was on a mail-coach, and as soon as we came to a public-house, the coachman pulled up for the fraction of a second. He did so when we came to a second public-house, and I then asked him the reason. He pointed to the off-hand wheeler, and said that she had been long completely blind, and she would stop at every place on the road at which she had before stopped. He had found by experience that less time was wasted by pulling up his team than by trying to drive her past the place, for she was contented with a momentary stop. After this I watched her, and it was evident that she knew exactly, before the coachman began to pull up the other horses, every public-house on the road, for she had at some time stopped at all. I think there can be little doubt that this mare recognised all these houses by her sense of smell. With respect to cats, so many cases have been recorded of their returning from a considerable distance to their homes, after having been carried away shut up in baskets, that I can hardly disbelieve them, though these stories are disbelieved by some persons. Now, as far as I have observed, cats do not possess a very acute sense of smell, and they seem to discover their prey by eyesight and by hearing. This leads me to mention another trifling fact: I sent a riding-horse by railway from Kent *viâ* Yarmouth, to Freshwater Bay, in the Isle of Wight. On the first day that I rode eastward, my horse, when I turned to go home, was very unwilling to return towards his stable, and he several times turned round. This led me to make repeated trials, and every time that I slackened the reins, he turned sharply round and began to trot to the eastward by a little north, which was nearly in the direction of his home in Kent. I had ridden this horse daily for several years, and he had never before behaved in this manner. My impression was that he somehow knew the direction whence he had been brought. I should state that the last stage from Yarmouth to Freshwater is almost due south, and along this road he had been ridden by my groom; but he never once showed any wish to return in this direction. I had purchased this horse several years before from a gentleman in my own neighbourhood, who had possessed him for a considerable time. Nevertheless it is possible, though far from probable, that the horse may have been born in the Isle of Wight. Even if we grant to animals a sense of the points of the compass, of which there is no evidence, how can we account, for instance, for the turtles which formerly congregated in multitudes, only at one season of the year, on the shores of the Isle of Ascension, finding their way to that speck of land in the midst of the great Atlantic Ocean?

CHARLES DARWIN

The Sense of Smell in Animals

THE hypothesis put forward by Mr. Wallace in NATURE of the 20th ult., to explain the power possessed by some animals of

© 1873 Nature Publishing Group

finding their way back to their homes after having been conveyed from them in such a way as to preclude the possibility of their seeing the road by which they travelled, contains, I think, the solution of a hitherto perplexing problem. To ascribe this power, as is usual, to instinct in the customary sense of the term, is to give what Mr. Bain calls "an illusory explanation of repeating the fact in different language," and it is manifestly impossible to ascribe it to instinct, as that term is understood in the evolution theory of mind. I am glad to see a psychologist like Prof. Robertson giving in his adhesion to Mr. Wallace's view. But while in the main accepting it, and arguing forcibly in its favour, Prof Robertson hesitates to affirm that it affords an explanation of the whole of the facts in question. Is this failure, if failure there be, inherent in the explanation itself, or does it lie in our imperfect knowledge of the facts to be explained? That there are difficulties cannot be denied. For example, it is difficult, to say the least, for the human mind to form the conception of a sense of smell, so acute, so objective, and furnishing sensations so strongly persistent in the ideal, as to enable an animal by its means alone, to retrace unerringly long and devious roads travelled over but once, and under circumstances rendering impossible the co-ordination of sights and smells habitual to the animal. In such cases smell must be a much closer second, if second at all, to sight, than touch is in man. No blindfolded man could perform a like feat by means of unaided touch, nor, do I think, could a blind man, though with the blind this sense becomes, by the cultivation it receives through a hard necessity, greatly more acute than it is in normal cases. But difficulties like these are such, I believe, only because of our very limited acquaintance with the psychology of the lower animals. One of the chief desiderata in mental science is, it seems to me, such a psychology, based upon principles generalised according to strict inductive methods, from a body of numerous, varied, well-authenticated, and scientifically made observations of the domestic and other animals. A work of this kind we have not, but, I believe, the lines upon which it should be constructed are already laid down in Mr. Spencer's truly great work, the "Principles of Psychology." When this branch of psychological science has been brought into something like parallelism with human psychology, difficulties, such as I have hinted at, will, I venture to say, be effectually removed, and Mr. Wallace's explanation will, as he claims for it, "cover all the well-authenticated cases of this kind."

In the extended scope claimed for this hypothesis by Prof. Robertson, viz., as explanatory of the nature of external perception in dogs, there appears to be a difficulty raised. The most refined and deep-penetrating psychological analysis, of both the empiristic and evolution schools, have incontestably established that our mature visual presentations are but symbols of the earlier and really genetic presentations acquired through touch combined with muscular feeling. Granting, as seems undeniable, that smell in dogs holds, in many respects, a place analogous to that of touch in man, would the earliest and the genetic presentations of externality in these animals be those furnished by smell, with or without the aid of muscular feeling?

Before concluding my letter, I should like to offer a remark upon the supposed *experimentum crucis* of Mr. Wallace's hypothesis, suggested by Mr. Bennett. The smell of stale fish would undoubtedly interfere with and overpower ordinary smells in the human organ. But is it not an anthropomorphical fallacy to assume, as Mr. Bennett appears to do, that such would be the result in the case of a cat? From the almost purely subjective and comparatively undeveloped sense of smell possessed by man, there appears to me to be no conclusive argument to the highly objective and extremely acute sense of smell possessed by certain animals. We are not warranted from our own experience in inferring of a sense, quantitatively, if not qualitatively, so very different, that one powerful sensation must necessarily exclude fainter sensations of a like order. Normally, vivid sensations of a particular order do tend to exclude with more or less completeness fainter like sensations. But the animal, in the circumstances in which it is placed, is as Mr. Wallace shows, in an abnormal condition. Its attention is concentrated on the unfamiliar succession of smells it is encountering, and under such a stimulus these ordinarily fainter sensations may not unreasonably be supposed to become unwontedly vivid, and capable of powerfully affecting the animal's consciousness, despite the resistance of what under common circumstances would prove an effectual obstacle to their conscious presentation. A complete *experimentum crucis* would require that the animal should, during the whole journey, be entirely smell-muffled, and Mr. Bennett's expedient could not, I think, be relied upon to produce this effect.

Camberwell, March 3 W. H. BREWER

External Perception in Dogs

THE following somewhat remarkable instance of a dog finding its way back was told me by the owner, who lived 20 or 25 miles up (and on the left bank of) the river Canumá, in Brazil; a small river just east of the river Madeira. He took the dog by boat down the river Canumá and up the Madeira to Borba, a small town on the right bank of the latter river; a distance of 70 or 80 miles round; and left the dog there. The dog ran away from Borba and made its way back to its former home on the river Canumá. More exactly, it was making its way back, for my informant being out in the wood some little way inland, and S.W. of his cottage, fell in with it. It was in bad condition, having been some weeks—the exact time could not be ascertained—in working its way back through the forest, and of course had lived by hunting. I cannot give with any exactness the distance overland from Borba: perhaps it is less than 25 miles; and in this respect the return is not remarkable. It seems to me that the dog during its journey by water must have had a constant perception of the bearing of its old home; and on the other hand that it made its way back not by any blind instinct but by trial and error and by recognition of the character of the forest. F. R. G. S.

Sight in Dogs

I THINK Mr. Kingsley rather underrates the exercise of the organs of vision by the dog when, in comparing it with the horse, he writes,—"The dog, who has smelt everything, but looked at very little." Now it is true that the dog does not look about him when on his travels, in the popular sense, by turning his head about, but close observation shows the eyeball in constant movement, taking in everything in front and on both sides, although, to all appearance, with his head close to the ground, his whole attention is concentrated on the reception of external impressions through his nose. This is particularly noticeable in the terrier, which, on meeting you, however intently he may seem to be engaged in smelling, gives a quick glance at your face without moving his head, or apparently lessening the attention he is paying to something else with his nose. Note, also, how quickly a dog going down wind sees another a long distance off.

The horse not only sees and smells acutely but also frequently touches any object with his upper lip.

In reference to the quotation from "Boswell's Life of Johnson," given by Mr. Nicoll, I may mention that it is well known to huntsmen that horses are very prone to kick if led near the hounds when a fox is being broken up, the explanation always given being that it is the smell of blood which irritates them.

Faringdon, March 9 J. HOPKINS WALTERS

Selenium

VITREOUS selenium may be considered a non-conductor of electricity. It is only when in a crystalline condition that it becomes a conductor.

A bar now in my possession, 2·25 × ·5 × ·05 inches, tested with an electromotive force of $\frac{1}{10}$th of a Daniell's cell, gives a deflection of 140 divisions on the scale of an ordinary astatic mirror galvanometer. The same deflection produced under the same conditions through a known resistance, shows the resistance of the selenium to be 360,000 ohms. By the well-known Bridge system the resistance of the same plate of selenium is 359,500 ohms, the two different tests thus confirming each other.

I have to leave this evening for Valentia to report on the electrical condition of the Anglo-American Company's cable, or would write you more fully on the effect of light on the conductibility of selenium.

If selenium be exposed to the direct rays of the sun, it gradually becomes crystalline. May not the explanation of the phenomenon be found in this fact?

All the bars I have experimented upon have been supplied by Mr. H. Bassett, No. 215, Hampstead Road.

WILLOUGHBY SMITH

Wharf Road, City Road, March 11

© 1873 Nature Publishing Group